POLISHING METHOD FOR SEMICONDUCTOR DEVICE, METHOD FOR FABRICATING SEMICONDUCTOR DEVICE AND POLISHING SYSTEM

BACKGROUND OF THE INVENTION

In recent years, as the size of semiconductor devices has been reduced, improvement of the flatness of interlevel insulating films has become essential to ensuring DOF (depth of focus) in lithography processes. This requires planarization with a CMP (chemical mechanical polishing) technique. Also, a Cu interconnect is desired to be used in order to reduce interconnect resistance. In forming a Cu interconnect, polishing using CMP is necessary because dry-etching is difficult to be performed.

In CMP, a wafer surface is brought into direct contact with a polishing cloth to perform polishing. Thus, scars or scratches are quite possibly generated, and therefore reducing scratches is the most important challenge in CMP. Up until now, several measures for reducing scratches have been proposed. Specifically, scratching on a wafer surface is prevented by breaking abrasive, aggregate particles generated in a slurry into pieces with an ultrasonic wave or removing aggregate particles with a filter (see, e.g., Japanese Unexamined Patent Publication No. 2001-150346).

FIG. **1** is a diagram illustrating a slurry supply apparatus disclosed in the above-described publication. The slurry supply apparatus of FIG. **1** includes a slurry supply unit **101**, a slurry circulation line **102** connected to the inlet and outlet of the slurry supply unit **101** and an ultrasonic-wave generator **103**. A slurry in the slurry circulation line **102** is circulated by a first pump **106**. The ultrasonic-wave generator **103** for irradiating the slurry with an ultrasonic wave is connected to the slurry circulation line **102**.

The slurry circulation line **102** and a CMP apparatus **105** are connected with each

other by a pipe **110**. Along the pipe **110**, a filter **104** for filtering condensed slurry particles is provided. Moreover, in the pipe **110**, a second pump **108** for drawing a slurry from the slurry circulation line **102** and supplying it to the CMP apparatus **105** is provided. Note that a valve **107** for adjusting the amount of the slurry to be supplied to the CMP apparatus **105** while controlling slurry supply to the CMP apparatus and stop of the slurry supply is provided between the filter **104** and the second pump.

In the slurry supply apparatus shown in FIG. **1**, an ultrasonic-wave generator **103** is provided on the slurry circulation line **102** and the slurry circulating in the slurry circulation line **102** is irradiated with an ultrasonic wave. Thus, condensation of slurry particles can be prevented. That is to say, although fine silica aggregate particles contained in the slurry are tend to link together to form large aggregate particles in the slurry circulation line **102**, linked particles in large aggregate particles can be separated by an ultrasonic wave generated by the ultrasonic-wave generator **103**. Thus, a slurry containing fine particles can be stably supplied to the CMP apparatus **105**. Moreover, dusts or the like contained in the slurry can be removed by the filter **104** so that a clean slurry can be supplied to the CMP apparatus **105**. Furthermore, the slurry contains no large, aggregate particle, so that the life of the filter **104** can be improved.

SUMMARY OF THE INVENTION

In the above-described publication, it is described that condensation of slurry particles can be prevented with the ultrasonic-wave generator **103** shown in FIG. **1**. However, the present inventors conducted experiments to find that even if the ultrasonic-wave generator **103** is provided, scars and scratches are generated on a wafer surface in CMP. Moreover, the present inventors also found that even if a filter is provided, there are cases where the generation of scars and scratches on a wafer surface can not be prevented.

As has been described, with reduction in the size of semiconductor devices, CMP has become an essential technique. Therefore, it is very difficult to determine not to use a CMP technique because scars and scratches are very possibly generated during CMP.

In view of the above-described problems, the present invention has been devised and it is therefore a main object of the present invention to provide a polishing system in which the generation of scars and scratches on a wafer surface is suppressed. Another object of the present invention is to provide a CMP technique and a polishing method for a semiconductor device in which the generation of scars and scratches on a wafer surface is suppressed and also to provide a method for fabricating a semiconductor device including the polishing method.

A first polishing method for a semiconductor device in accordance with the present invention is a polishing method which is part of a method for fabricating a semiconductor device, the fabrication method including the process step of polishing a substrate using CMP, and characterized in that in the polishing process step, a tube-type slurry supply pump is used for supplying a slurry, and in the tube-type slurry supply pump, a vinyl chloride type tube is used as a tube for supplying the slurry.

It is preferable that the vinyl chloride type tube substantially does not contain fine particles for reinforcing the strength of the tube.

A second polishing method for a semiconductor device in accordance with the present invention is a polishing method which is part of a method for fabricating a semiconductor device, the fabrication method including the process step of polishing a substrate using CMP, and characterized in that in the polishing process step, a tube-type slurry supply pump is used for supplying a slurry, and in the tube-type slurry supply pump, a tube including the inner surface formed of a vinyl chloride type tube and the outer surface formed of a rubber type tube is used as a tube for supplying the slurry.

It is preferable that the vinyl chloride type tube substantially does not contain fine particles for reinforcing the strength of the tube.

A third polishing method for a semiconductor device in accordance with the present invention is a polishing method which is part of a method for fabricating a semiconductor device, the fabrication method including the process step of polishing a substrate using CMP, characterized in that in the polishing process step, a tube-type slurry supply pump is used for supplying a slurry, and a filter for removing aggregate particles and a foreign substance contained in the slurry is disposed downstream of the slurry supply pump.

In the tube-type slurry supply pump, a tube in which at least the inner surface is formed of a vinyl chloride material may be used as a tube for supplying the slurry.

A fourth polishing method for a semiconductor device in accordance with the present invention is a polishing method which is part of a method for fabricating a semiconductor device, the fabrication method including the process step of polishing a substrate using CMP, and characterized in that in the polishing process step, a tube-type slurry supply pump is used for supplying a slurry, and in the tube-type slurry supply pump, a tube which substantially does not contain fine particles for reinforcing the strength of the tube is used as a tube for supplying the slurry.

In an embodiment of the present invention, the tube is a vinyl chloride type tube or a silicon rubber type tube.

A method for fabricating a semiconductor device in accordance with the present invention includes any one of the polishing methods.

A first polishing system in accordance with the present invention is a system for polishing a substrate using CMP and includes: a CMP apparatus for polishing the substrate; and a tube-type slurry supply pump for supplying a slurry during polishing. In the system, a tube for the tube-type slurry supply pump is a tube in which at least the inner

surface is formed of a vinyl chloride material.

In another embodiment of the present invention, the tube has a two-layer structure, the inner surface of the tube is formed of a vinyl chloride material and the outer surface of the tube is formed of a rubber material.

A second polishing system in accordance with the present invention is a system for polishing a substrate using CMP and included: a CMP apparatus for polishing the substrate; a slurry supply apparatus for supplying a slurry to the CMP apparatus; a pipe for connecting the slurry supply apparatus and the CMP apparatus; and a tube-type slurry supply pump disposed in part of the pipe. In the system, a filter for removing at least aggregate particles or a foreign substance contained in the slurry is disposed between the tube-type slurry supply pump and the CMP apparatus.

It is preferable that a tube for the tube-type slurry supply pump is a tube in which at least the inner surface is formed of a vinyl chloride material.

A third polishing system in accordance with the present invention is a system for polishing a substrate using CMP and includes: a CMP apparatus for polishing a substrate; and a tube-type slurry supply pump for supplying a slurry during polishing. In the system, a tube for the tube-type slurry supply pump substantially does not contain fine particles for reinforcing the strength of the tube.

According to the present invention, in fabricating a semiconductor device with a method including the process step of polishing a substrate using CMP, a vinyl chloride type tube is used as a tube for supplying a slurry in a tube-type slurry supply pump used in the polishing process. Thus, the generation of scars and scratches on a wafer surface can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating the configuration of a known slurry supply apparatus.

FIG. **2** is a view illustrating an example on how a slurry is supplied.

FIG. **3** is a view illustrating another example on how a slurry is supplied.

FIG. **4** is an enlarged cross-sectional view partially illustrating a tube-type slurry supply pump.

FIG. **5** is a diagram schematically illustrating the configuration of a polishing system in accordance with a first embodiment of the present invention.

FIG. **6** is an enlarged cross-sectional view partially illustrating a tube-type slurry supply pump.

FIG. **7** is a view schematically illustrating the configuration of a measurement apparatus for measuring particles generated from a tube.

FIG. **8** is a graph showing the relationship between each tube type and the number of released particles.

FIG. **9** is a graph showing the number of microscratches after a tube is change to a rubber type tube or a vinyl chloride type tube.

FIG. **10** is a graph showing product yield when a rubber type tube and a vinyl chloride type tube are actually used.

FIG. **11** is a view illustrating a cross-sectional structure of a tube having a two-layer structure.

FIG. **12** is a view schematically illustrating the configuration of a polishing system in accordance with a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, embodiments of the present invention will be described in detail with

reference to the accompanying drawings. Note that the present invention is not limited to the following embodiments.

First, description will be made on a phenomenon in which scars and scratches are generated on a wafer surface in performing CMP and which the present inventors examined, before embodiments of the present invention.

Large particles resulting from cohesion of a slurry and a foreign substance existing in a slurry are considered to be possible causes of the generation of scars and scratches on a wafer surface in CMP. As measures for coping with this, a technique for eliminating large particles in which aggregate particles are broken into pieces so as to be fine particles and a technique for removing large particles and a foreign substance with a filter have been used.

FIG. **2** schematically illustrates the configuration of a system using the former technique. Meanwhile, FIG. **3** schematically illustrates the configuration of a system using the latter technique.

Each of the configurations of FIGS. **2** and **3** includes a slurry supply apparatus **1**, a CMP apparatus **3** and a pipe **2** for delivering a slurry to the CMP apparatus **3**. The slurry supply apparatus **1** is an apparatus for adjusting or buffering a slurry and supplying the slurry to the CMP apparatus **3**. Moreover, the CMP apparatus **3** is an apparatus for polishing the surface of a substrate (e.g., a wafer on which a semiconductor integrated circuit has been formed) by chemical mechanical polishing (CMP) to planarize the surface. The slurry in the pipe **2** is pushed out by a tube-type pump **15** and then supplied to a polishing mechanism unit of the CMP apparatus **3**.

Note that in the configuration of FIG. **2**, an ultrasonic-wave generator **4** for breaking aggregate slurry particles into pieces is provided. On the other hand, in the configuration of FIG. **3**, a filter **5** for catching aggregate slurry particles and a foreign

substance in a slurry is provided.

A polishing slurry is mixed with, for example, an oxidizer, or merely held as a buffer in the slurry supply apparatus **1**. At this time, the slurry is, in general, intermittently stirred to prevent precipitation of abrasive particles generated due to polishing. However, with mechanical pressure applied, aggregation of abrasive particles occurs, thereby generating large particles in the slurry. Then, the slurry containing large particles is delivered to the CMP apparatus **3** through the pipe **2** by the tube-type pump **15**.

With the configuration of FIG. **2**, if large particles are broken into pieces by irradiating the slurry with an ultrasonic wave by the ultrasonic-wave generator **4**, the slurry containing no large particles should be supplied to the CMP apparatus **3**, thus preventing scratches on a wafer surface. On the other hand, with the configuration of FIG. **3**, if large particles and a foreign substance in the slurry are caught by the filter **5**, a slurry containing no large particles and no foreign substance should be supplied to the CMP apparatus **3**, thus preventing scratches on a wafer surface.

However, in both of the configurations of FIGS. **2** and **3**, actually, scratches on a wafer surface could not be completely prevented. The present inventors, then, made the following assumption. Although it has been considered that aggregate particles and a foreign substance in a slurry largely cause scars on a wafer surface, there should be some other causes of scars on the surface.

The present inventors conducted a further examination to find that a foreign substance generated in the CMP apparatus **3** or the tube-pump-type slurry supply pump **15** located in the vicinity of the CMP apparatus **3** induced scratches on a wafer surface. FIG. **4** is an enlarged view partially illustrating the tube-type slurry supply pump **15** shown in FIGS. **2** and **3**.

As shown in FIG. **4**, the tube-type slurry supply pump **15** includes a pump-body-

side receiver **6** and a fluid delivery pump roller 7. The pump-body-side receiver **6** is a member to which a tube is pressed for delivering a slurry **10**, and the fluid delivery pump roller 7 has the function of pressing a slurry delivery tube **8** to the pump-body-side receiver **6** and squeezing the tube to push the slurry out. That is to say, the fluid delivery roller 7 rolls in the direction of the arrow of FIG. **4** and thereby squeezes the tube **8** to deliver the slurry **10**. Note that the slurry delivery tube **8** is connected to the pipe **2**.

As shown in FIG. **4**, the tube-type pump which is provided in the CMP apparatus **3** or in the proximity of the CMP apparatus **3** and is used for supplying a slurry presses the slurry delivery tube **8** to the pump-body-side receiver **6** with the fluid delivery roller 7 and squeezes the tube to deliver the slurry **10**. As the slurry delivery tube **8**, a rubber type tube with high mechanical strength is used in many cases. In such a case, the rubber slurry delivery tube **8** contains a reinforcing material for attaining elasticity. Such reinforcement materials include particles **9** of SiO_2, Al_2O_3 or the like, in general. In other words, to reinforce the mechanical strength of the tube, the rubber type tube is made to contain the fine particles **9** of SiO_2, Al_2O_3 or the like. The size of the particles **9** is from several μm to several hundred μm.

The slurry delivery tube **8** is pressed to the pump-body-side receiver **6** by the fluid delivery roller 7. Thus, the particles **9** in the tube **8** are diffused as particles **11** in the slurry **10**. Then, the slurry **10** containing the particles **9** is supplied to the CMP apparatus shown in FIGS. **2** and **3**, thus resulting in the generation of scars and scratches on a wafer surface in polishing.

In this case, even if an ultrasonic wave is irradiated or a filter is provided right after the slurry supply apparatus (immediately downstream of the slurry supply apparatus), a foreign substance generated from the tube pump can not be removed. Accordingly, scratches can not be reduced.

Then, the present inventors have completed, based on the above-described findings, a CMP technique which allows reduction in scars and scratches on a wafer surface to reach the present invention.

Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings. In the drawings, components with the same function are identified by the same reference numeral for simplicity of description. Note that the present invention is not limited to the following embodiments.

(EMBODIMENT 1)

A first embodiment of the present invention will be described with reference to FIGS. **5** and **6**. FIG. **5** is a view schematically illustrating the configuration of a polishing system in accordance with the present invention. FIG. **6** is a partially enlarged view schematically illustrating the cross-sectional structure of a tube-type slurry supply pump **15**.

The polishing system of FIG. **5** is a system for polishing a substrate using CMP and includes a CMP apparatus **3** for polishing a substrate and a tube-type slurry supply pump **15** for supplying a slurry during polishing. The tube-type slurry supply pump **15** is connected to a slurry supply apparatus **1** by a pipe **2**.

The tube-type slurry supply pump (which will be herein referred to as the "tube-type pump") **15** is a pump for supplying a slurry to a polishing mechanism unit of the CMP apparatus **3**. In this embodiment, as a tube (slurry delivery tube) **12** for the tube-type pump **15**, a vinyl chloride type tube made of vinyl chloride resin is used. The vinyl chloride type tube **12** does not contain fine particles (SiO_2, Al_2O_3 or the like) as a reinforcement material which has been conventionally needed for a rubber type tube. Accordingly, fine particles are not diffused in the slurry **10**, as shown in FIG. **6**. Since there is no fine particle in the slurry **10**, a slurry containing no fine particle (i.e., no foreign substance) is supplied to the

CMP apparatus **3** of FIG. **3**. As a result, polishing can be performed without generating scars and scratches on a wafer surface. Thus, polishing method and system for a semiconductor device with which product yield is not reduced can be provided.

Next, an experiment which the present inventors conducted to confirm effects of the CMP technique of the first embodiment of the present invention and the results of the experiment will be described.

First, before confirming the generation of scratches on a wafer surface due to polishing, how particles are to be generated from a tube was examined for six types of tubes. The six types of tubes were: four types of rubber type tubes (A through D); a type of silicon tube (E); and a type of vinyl chloride type tube (F).

FIG. **7** is a view schematically illustrating the configuration of a measurement apparatus used for measuring particles generated from the tubes. As shown in FIG. 7, a tube **40** of each type was installed to the tube-type slurry supply pump **15** and then pure water was delivered. The delivered pure water was measured with an in-fluid-particle counter **30** connected to a downstream region of the tube. In this manner, it has been confirmed how particles with a size of 0.2 μm or more are generated. The results of the measurement are shown in FIG. **8**.

FIG. **8** is a graph showing the number of particles (the number of particles with a size of 0.2 μm or more) released into pure water after consecutive 12-hour deliverly of pure water. As can be seen from FIG. **8**, in the rubber type tubes which are of a type presently used, a large quantity of particles (about 1000 particles/ml) were released into pure water even after 12 hours. On the other hand, as for each of the vinyl chloride type tube and the silicon tube, the number of particles released into pure water was about 0.5 particles/ml. That is to say, the numbers of released particles in the vinyl chloride type tube and the silicon type tube were the level at which almost no particle was detected.

Herein, a rubber type tube which is presently used means to be an ethylene propylene rubber tube containing ethylene propylene terpolymer as a main component. The tube contains inorganic fillers such as SiO_2 and Al_2O_3. Other rubber type tubes also contain inorganic fillers. Tubes containing inorganic fillers cause the generation of scars and scratches on a wafer surface due to the same mechanism.

The vinyl chloride type tube used in this embodiment is a polyvinyl chloride (PVC) tube and contains a plasticizer and a stabilizer. The polyvinyl chloride type tube contains no inorganic filler and has a good resistance to wear. As for even a tube other than vinyl chloride type tubes, as long as it contains no inorganic filler, fine particles are not diffused in a slurry, so that the generation of scars and scratches on a wafer surface can be prevented.

The results shown in FIG. **8** indicate that it is possible to reduce the number of particles by using the vinyl chloride type tube and the silicon type tube of the six tubes. When the vinyl chloride type tube and the silicon type tube are compared to each other, the life of the vinyl chloride type tube is about 10 times longer than that of the silicon type tube. Therefore, in view of practical use, it is preferable to use the vinyl chloride type tube as a tube for the tube-type pump **15** of this embodiment. Needless to say, the silicon type tube can be used to perform CMP if life and costs are not considered. Note that the vinyl chloride type tube is advantageously at a lower price than that of the silicon type tube.

Since a tube for the tube-type slurry supply pump has been required to have as a long life as possible, rubber type tubes with higher mechanical strength than those of other types of tubes have been presently used. Moreover, rubber type tubes are low in cost and no adverse effect resulting from rubber type tubes has been yet reported. Therefore, rubber type tubes are still widely used today.

As has been described, the present inventors found problems in using a rubber type

tube. Thus, in order to prevent the generation of scars and scratches on a wafer surface, the inventors have decided to use a tube (specifically, a vinyl chloride type tube) which substantially does not contain fine particles for reinforcing the strength of the tube, even if life properties of the tube are reduced.

Next, results obtained by examining with an optical defect inspector the number of microscratches generated on a wafer surface after tube exchange are shown in FIG. **9**. As can be seen from the examination results of scratches on a wafer surface shown in FIG. **9**, scratches on the surface of a wafer immediately after tube exchange could be reduced from several hundred scratches per wafer to about 10 scratches per wafer by changing a rubber type tube to a vinyl chloride type tube.

Moreover, FIG. **10** is a graph showing product yield when the rubber type tube and the vinyl chloride type tube were actually used in a CMP process. That is to say, the results shown in FIG. **10** indicate the effect of improving product yield achieved by using the vinyl chloride type tube. As can be seen from FIG. **10**, actual product yield was improved by 10%-20% at most by changing the rubber type tube to the vinyl chloride type tube. In this embodiment, a tube having an outer diameter of 6.35 mm and an inner diameter of 3.18 mm was used. However, the present invention is not limited thereto. Preferable outer and inner diameters may be appropriately selected considering the type of a pump or the like.

As has been described, by changing a tube to the vinyl chloride type tube, scratches on a wafer surface can be reduced, thus resulting in improved product yield. According to the examinations which the present inventors conducted, it has been confirmed that inorganic fillers are released out most at the time when a rubber type tube is exchanged with new one. Therefore, immediately after the rubber type tube has been exchanged with new one, a large number of particles with a size of 0.2 μm are generated and thus the CMP

apparatus can not be immediately set to be in an operation state. In order to suppress filler release, running has to be performed. To perform running, several days are required and a particle check also has to be performed for several times. Therefore, the CMP apparatus can not be immediately set to be in an operation state.

As in this embodiment, however, if the vinyl chloride type tube is used, the generation of particles can be suppressed even immediately after tube exchange. Accordingly, the CMP apparatus can be immediately set to be in an operation state. Moreover, the vinyl chloride type tube releases far less particles than the rubber type tube in a stable state. Therefore, use of the vinyl chloride type tube is more advantageous than use of the rubber type tube. Thus, it should be noted that even if the life of the vinyl chloride type tube is shorter than that of a rubber type tube and thus the number of tube exchanges in a predetermined period is increased, the vinyl chloride type tube has a great significance from a technical view point because less particles are generated even immediately after tube exchange in the case of the vinyl chloride type tube.

With reduction in the size of semiconductor devices, particles, scars, scratches or the like on a wafer surface, which cause reduction in yield, have to be controlled at a finer level. At the conventional or present level, it is required in many cases to control particles with a size of 0.3 μm or more on an oxide film. However, it will be required to control components having a smaller size. For example, particles with a size of about 0.2 μm are preferably controlled. The present invention has been devised to achieve a CMP technique at a level at which particles, scars and scratches are not detected even if a control is performed using a measurement apparatus with higher accuracy. This target, then, has been successfully achieved by using the vinyl chloride type tube as the slurry delivery tube.

Note that the reason why the tube-type slurry supply pump is used as the pump **15**

for pushing the slurry out is that in addition to the fact that this type of pump is low in cost, the pump has high metering accuracy in supplying a slurry and less pulsating flows. The tube-type slurry supply pump presses a tube to push the slurry out. Thus, if a tube made of a rubber material (e.g., raw rubber) which does not contain a reinforcement material such as inorganic fillers is used, the mechanical strength of the tube is so small that the tube can not be used, as it is, as a tube for the tube-type slurry supply pump. Therefore, it is necessary to make a rubber material contain a reinforcement material such as inorganic fillers. In contrast, since a vinyl chloride material has sufficient mechanical strength, it is not needed to make the vinyl chloride material contain inorganic fillers or the like, while it is preferable to make it contain a plasticizer to increase flexibility.

Examples of the process step of polishing a substrate by CMP included in a method for fabricating a semiconductor device are the process step of forming an STI (shallow trench isolation), the process step of planarizing an interlevel insulating film, the process step of forming a tungsten plug or a silicon plug, the process step of forming a damascene interconnect (e.g., the process step of forming a Cu interconnect), and the like. With recent reduction in the size of semiconductor devices, a Cu interconnect technique is essential in a 0.15 μm design rule or smaller (more specifically, a 0.13 μm design rule or smaller). Therefore, the technical significance of the CMP technique in which the generation of scars and scratches on a wafer surface is suppressed is very important. In other words, the CMP technique of embodiments of the present invention is particularly useful in fabricating a semiconductor device of a 0.15 μm design rule or smaller (more specifically, a 0.13 μm or smaller). Moreover, the CMP technique of embodiments of the present invention exhibits greater effects in fabricating a semiconductor device using a copper interconnect than in fabricating a semiconductor device using an aluminum interconnect.

A substrate to be polished by the CMP apparatus **3** is typically a semiconductor wafer

(a silicon wafer or an SOI substrate) on which a semiconductor integrated circuit has been formed. In many cases, a single or multiple layers are formed on the semiconductor wafer. In this specification, if another layer is formed on a substrate, the substrate and said another layer as a whole may be called "substrate" for the purpose of convenience. As for a semiconductor wafer on which a semiconductor integrated circuit has been formed, even if the semiconductor wafer is not completed as a final product (e.g., a semiconductor chip or an IC chip), the wafer may be called "semiconductor device".

In the above-described embodiment, a tube entirely made of a vinyl chloride material is used as the tube **12** of the tube-type slurry supply pump **15**. However, part of the tube which does not contain fine particles such as inorganic fillers has to exist only in the inner surface of the tube which has a contact with the slurry. Therefore, a tube having the inner surface made of a vinyl chloride material and the outer surface made of some other material may be used. FIG. **11** is a view illustrating a cross-sectional structure of a tube having a two-layer structure. The tube of FIG. **11** includes an inner pipe **13** (e.g., a vinyl chloride type tube) made of the same material (e.g., vinyl chloride) as that of a tube containing no particles of a reinforcement material or the like and an outer pipe **14** formed so as to cover the inner pipe **13**. The outer pipe **14** is, for example, a rubber type tube which contains particles of, for example, a material for reinforcing the tube but has high mechanical strength.

As has been described, even if a tube in which at least the inner surface is made of a vinyl chloride material is used, a slurry in which no foreign substance is diffused can be supplied to the CMP apparatus **3**, as in the same manner as in the case where the vinyl chloride type tube is used. Thus, polishing can be performed without causing the generation of scars and scratches on a wafer surface. Moreover, a material with high mechanical strength is used for the outer surface, so that the life of the tube can be increased. Note that it is also possible to provide another outer layer so as to form three- or more-layer structure.

Note that the configurations of FIGS. **2** and **3** have been described as examples in which a rubber type tube is used. However, if a vinyl chloride type tube is used as a tube for the tube-type pump **15**, the ultrasonic-wave generator **4** and the filter **5** can be used for the purpose of dividing aggregate particles of the slurry and removing dusts or the like contained in the slurry, as shown in FIGS. **2** and **3**.

(EMBODIMENT 2)

A second embodiment of the present invention will be described with reference to FIG. **12**. In the first embodiment, the vinyl chloride type tube is used as the tube **12** of the tube-type slurry supply pump **15**, thereby suppressing the generation of scars and scratches on a wafer surface. In the second embodiment, as shown in FIG. **12**, a filter **16** is provided downstream of the slurry supply pump **15** to suppress the generation of scars and scratches on a wafer surface.

The filter **16** functions to remove aggregate particles and a foreign substance contained in a slurry. If a rubber type tube is used for the tube of the tube-type slurry supply pump **15**, the filter **16** functions to remove a foreign substance (e.g., inorganic fillers) diffused from the rubber type tube. The tube-type pump **15** is disposed in the CMP apparatus **3** in FIG. **12**. However, the tube-type pump **15** may be disposed in the vicinity or in the proximity of the CMP apparatus **3**. Moreover, the filter **16** may be disposed in the CMP apparatus **3**, or in the vicinity or in the proximity of the CMP apparatus **3**, as long as it is disposed downstream of the tube-type pump **15**.

Next, operations of the configuration of the polishing system in accordance with this embodiment.

Polishing slurry is mixed with, for example, an oxidizer, or merely held as a buffer in the slurry supply apparatus **1**. At this time, the slurry is, in general, intermittently stirred to prevent deposition of abrasive particles generated by polishing. However, with

mechanical pressure applied, aggregation of abrasive particles occurs, thus generating large particles in the slurry. Moreover, a foreign substance mixed into the slurry is diffused in the slurry by the stirring. Then, the slurry containing large particles and the foreign substance is delivered to the CMP apparatus **3** through the pipe **2**. Moreover, in the tube-type slurry pump **15**, the slurry is supplied by pressing the tube, so that a foreign substance might be mixed into the slurry from the tube. In this embodiment, the filter **16** is disposed downstream of the tube-type slurry pump **15**, thus substantially all of the large particles and the foreign substance contained in the slurry and the foreign substance generated in the tube-type pump **15** can be caught.

Note that in the configuration shown in FIG. **1**, a filter is disposed not downstream of (after) a pump but upstream of (before) the pump. The following is a possible reason for this. The filter for removing dusts or the like in a slurry has higher resistance to slurry delivery when loadings occur in the filter. The tube-type slurry pump is used to suppress pulsating flows and allow high, stable metering accuracy at a low cost. Thus, the filter whose resistance to slurry delivery might vary has to be located upstream of the pump. For the same reason, in the configuration shown in FIG. **3**, the filter is located upstream of the pump.

The examination conducted by the present inventors revealed that a foreign substance such as inorganic fillers is generated from the rubber type tube by the tube-type slurry pump **15**. Therefore, the generation of scars and scratches on a wafer surface can not be suppressed in the configurations of FIGS. **1** and **3**. Thus, the filter **16** has to be provided in part of the pipe **2** located between the tube-type slurry pump **15** and the CMP apparatus **3** even if the filter's resistance to slurry delivery might vary. Note that to reduce the generation of a foreign substance as well as to prevent the occurrence of loadings in the filter **16**, it is preferable to use a tube in which at least the inner surface is made of a vinyl

chloride material as a tube to be passed through the tube-type slurry pump **15**. If the occurrence of loadings in the filter **16** is prevented, the life of the filter **16** can be advantageously increased.

The present invention has been described by showing preferred embodiments. However, the description which has been made herein does not limit the present invention and various kinds of modification are possible. For example, the two-layer structure for a tube as a modified example of the first embodiment and the configuration described in the second embodiment may be combined.

As has been described, according to embodiments of the present invention, it is possible to suppress the generation of a foreign substance from a tube-type slurry supply pump, so that the generation of scars and scratches in CMP can be prevented. Therefore, polishing method and system for a semiconductor device, which allows high yield, can be provided. Moreover, it is also possible to use a tube from which a foreign substance is not generated while ensuring a long life for the tube. Accordingly, the generation of scars and scratches in CMP can be prevented. Therefore, polishing method and system for a semiconductor device, which allows high yield, can be provided. Furthermore, even if a foreign substance is diffused in a slurry, the diffused foreign substance can be caught. Accordingly, the generation of scars and scratches in CMP can be prevented. Therefore, polishing method and system for a semiconductor device, which allows high yield, can be provided.